

Claims

- 5        1. A system for detecting and diagnosing ear related conditions comprising:  
                a device capable of obtaining a spectrum of reflected light from  
                an ear of a subject; and  
                a processing unit in connection with said device which is  
                capable of translating the obtained spectrum of reflected light to one  
                or more output values related to the condition of the ear.
- 10      2. The system of claim 1 wherein the processing unit translates the  
                obtained spectrum by converting the obtained spectrum to at least  
                one digital value and by further comparing between the digital  
                value and at least one reference value.
- 15      3. The system of claim 1, wherein said device capable of obtaining a  
                spectrum of reflected light from an ear comprises:  
                a lamp; and  
                a light conveyor conveying reflected light from said ear to said  
                processing unit.
- 20      4. The system of claim 3, wherein said lamp includes a halogen  
                lamp.
5. The system of claim 3, wherein said light conveyor includes at  
                least one optical fiber.
6. The system of claim 2, wherein said processing unit comprises a  
                spectral analytical instrument, which receives said spectrum of  
                reflected light and produces an analog signal.

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- 1 The system of claim 6, wherein said spectral analytical instrument  
2 is a spectrometer.

3 The system of claim 7, wherein said spectrometer is sensitive to  
4 wavelengths of approximately between 400nm to 1200nm.

5 9. The system of claim 6, wherein said spectral analytical instrument  
6 includes at least one filter.

7 10. The system of claim 6, wherein said processing unit comprises a  
8 converter converting said analog signal into said at least one  
9 digital value.

10 11. The system of claim 10, wherein said processing unit further  
11 comprises a microprocessor interfaced with said converter .

12 12. The system of claim 11, wherein said microprocessor comprises  
13 an accessible memory.

14 13. The system of claim 1, wherein said processing unit comprises a  
15 display for displaying said one or more output values.

16 14. The system of claim 13, wherein said display includes an LCD  
17 display.

18 15. The system of claim 1, wherein said one or more output values  
19 indicate the health of the ear.

20 16. The system of claim 15, wherein said one or more output values  
21 indicate whether there is otitis media or serous otitis media.

22 17. The system of claim 16, wherein the statistical confidence of the  
23 decision is additionally indicated

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18. The system of claim 2, wherein said at least one reference value is at least one digital value resulting from diagnosing the other ear of said subject with said system.
  19. The system of claim 2, wherein said at least one reference value is at least one digital value resulting from a diagnosis of a healthy ear with said system.
  20. The system of claim 2, wherein said at least one reference value is a statistical range values resulting from healthy ears.
  21. The system of claim 2, wherein said at least one reference value is a statistical range values resulting from ears with otitis media.
  22. The system of claim 2, wherein said at least one reference value is a statistical range values resulting from ears with serous otitis media.
  23. The system of claim 2, wherein at least one digital value includes at least one digital value of an reflectance at wavelength of approximately 650-700nm, and wherein the processing unit further compares said value to a statistical reflectance at wavelength of approximately 650-700nm of a healthy ear thereby determining the redness degree of the tympanic membrane of said ear.
  24. The system of claim 2, wherein at least one digital value includes a digital value of an reflectance of wavelength of approximately 962 nm, and wherein the processing unit further compares said value to a statistical reflectance at wavelength of approximately 962 nm of a healthy ear thereby determining the effusion degree in the middle ear.

25. The system of claim 1, wherein said processing unit further comprises an input unit including at least a numeric keyboard and an LCD display, for inputting information, and for further saving said information with said one or more output values in a file.
  26. The system of claim 25, wherein said information includes at least one of the following: user data and the side of said ear.
  27. The system of claim 25, wherein said processing unit further comprises a clock for indicating the time and date of said one or more output values, and wherein the processing unit further saves said time and date with said one or more output values in said file.
  28. The system of claim 25, wherein said processing unit is in communication with a personal computer.
  29. The system of claim 1, wherein said system is incorporated into a single hand – held unit.
  30. The system of claim 29, wherein the single hand – held unit is an otoscope.
  31. The system of claim 1, wherein said device capable of obtaining a spectrum of reflected light is incorporated into an otoscope.
  32. The system of claim 1, wherein the processing unit is further connected to the internet.
  33. A method for detecting and diagnosing ear related conditions comprising operating the system of claim 1.
  34. A device for converting an otoscope into a system for detecting and diagnosing ear related conditions comprising:

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- a spectrometer that receives a reflect light from an ear and produces an electrical signal;
- an electro-optical cable that delivers said reflected light from an ear to an entrance slit of said spectrometer;
- an A/D converter that receives the output of said spectrometer in a form of an electrical signal and converts it to at least one digital value;
- a processor that receives said digital value, analyzes the information and saves it;
- a clock;
- an alphanumeric display connected to said processor and displays a result after processing is completed; and
- a keyboard connected to said processor that enables the entrance of data.
35. The device of claim 34, wherein the processing unit is in connection with an otoscope, and the combined components are capable of translating an obtained spectrum of reflected light to one or more output values related to the condition of the ear.
36. The device of claim 34, wherein said alphanumeric display is a LCD.
37. The device of claim 34, wherein said results that are displayed after processing is completed is either "normal" or serous otitis media" or "otitis media" or "undiagnosable".
38. A method for detecting and diagnosing ear related conditions comprising the steps of:
- illuminating inside an ear;

obtaining a spectrum of reflected light from an ear of a subject;  
converting said spectrum of reflected light to at least one digital  
value; and

5 calculating one or more output values based on said at least one  
digital value as compared to at least one reference value thereby  
detecting and diagnosing ear related conditions.

39. The method of claim 38, further comprising the step of initially

inputting to the processing unit information of the subject and the  
side of the ear.

10 40. A method for detecting and diagnosing ear related conditions  
comprising the steps of:

illuminating inside the ear;

15 inserting a device to the ear canal capable of conveying at least  
one spectrum of reflected light from said ear to a processing unit; and

activating said processing unit thereby translating at least one  
spectrum of reflected light provided at the time of activating to one or  
more output values related to the condition of the ear.

41. The method of claim 40, wherein the activating is by pressing a  
button located on said device.

20 42. A system for detecting and diagnosing ear related conditions  
comprising:

a device capable of obtaining a spectrum of reflected light from  
an ear of a subject; and

25 a processing unit in connection with said device which is  
capable of translating an obtained spectrum of reflected light by

converting said spectrum to at least one digital value, and by further comparing between said digital value and at least one reference value to produce at least one output value related to the condition of the ear.

- 5 43. A system for detecting and diagnosing ear related conditions comprising:

a device capable of obtaining a spectrum of reflected light from an ear of a subject; and

a processing unit in connection with said device that comprises a spectral analytical instrument, that receives said spectrum of reflected light and produces an analog signal translated to one or more output values related to the condition of the ear.

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